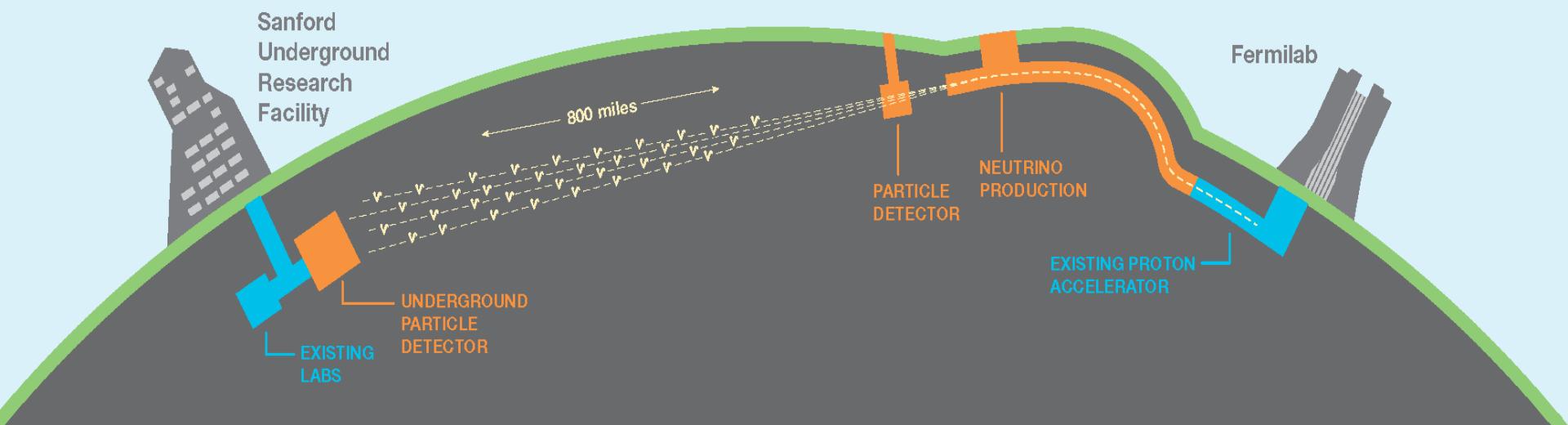
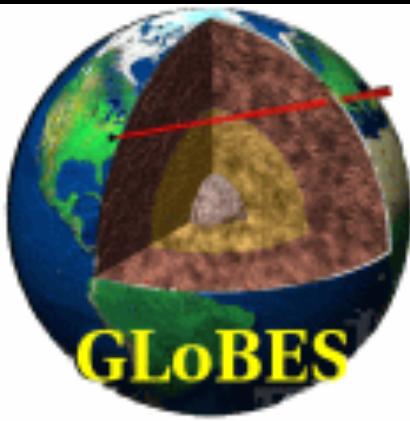


Modeling CPV Signal Sensitivities in the Deep Underground Neutrino Experiment



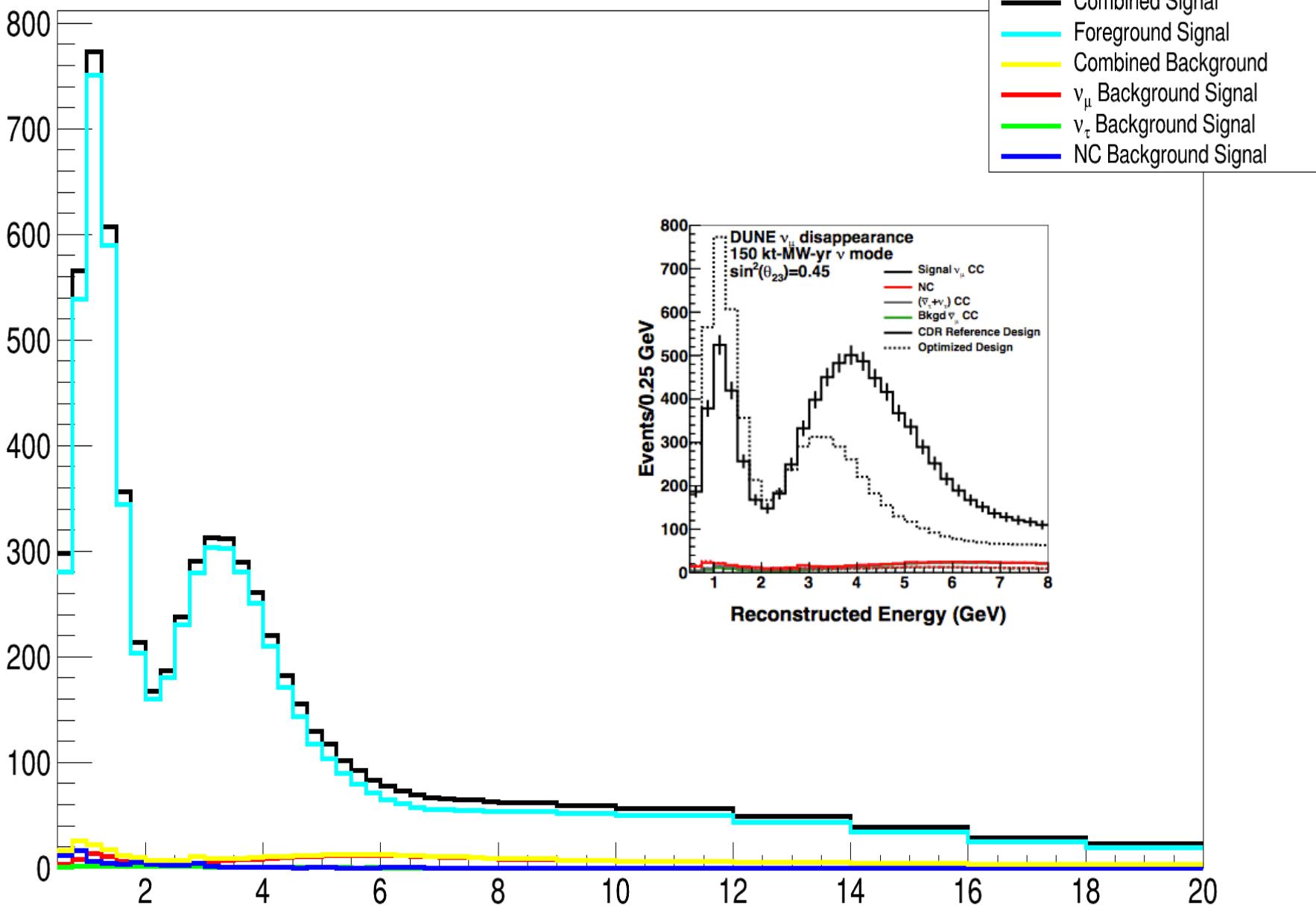
Outline:

- GLoBES output of the theorized neutral current (NC) signal
- Non-Standard Interaction (NSI) models, with and without NC
- Sterile Neutrino models, with and without NC
- Percentage δ_{cp} values at 3σ and 5σ for the modeled signals
- NC counts spectra for the high energy beam.
- 5+5 year optimized beam comparison to a mixed 3+3 and 2+2 optimized and high energy beam.

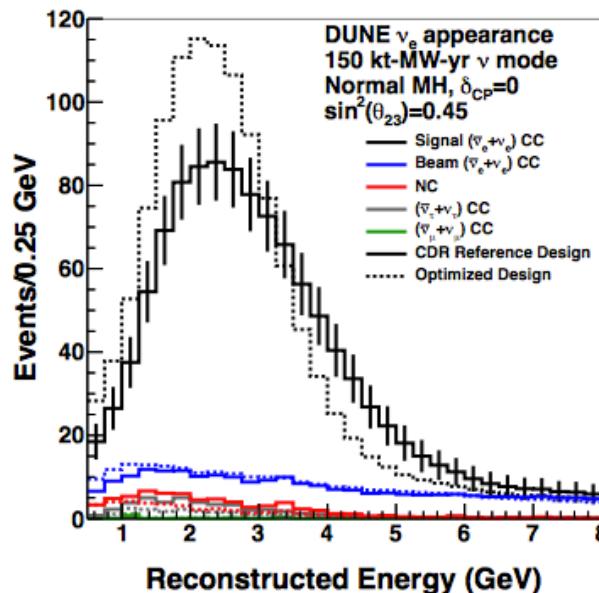
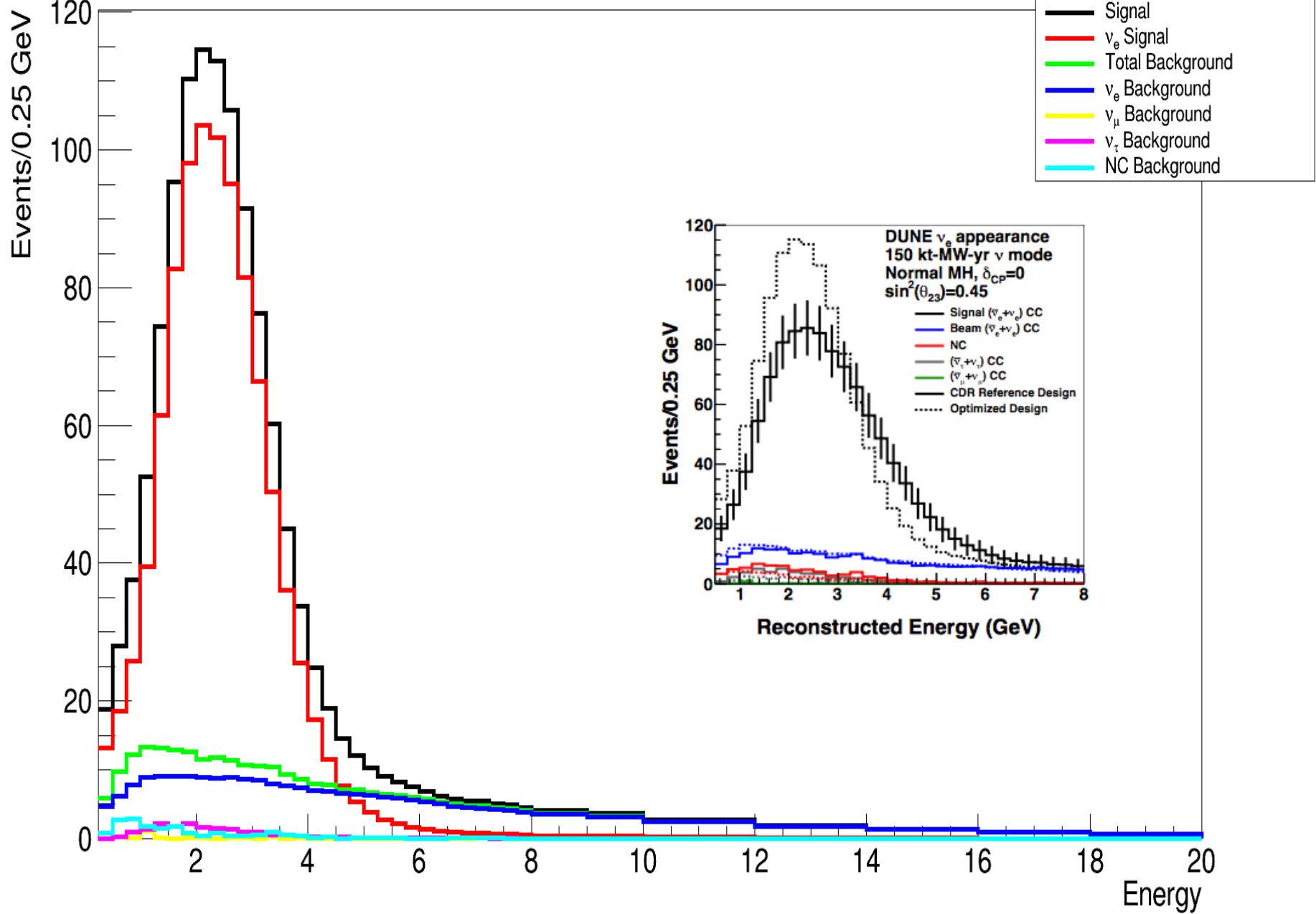


ROOT
Data Analysis Framework

ν_μ Charge Current Spectrum



ν_e Charge Current Spectrum

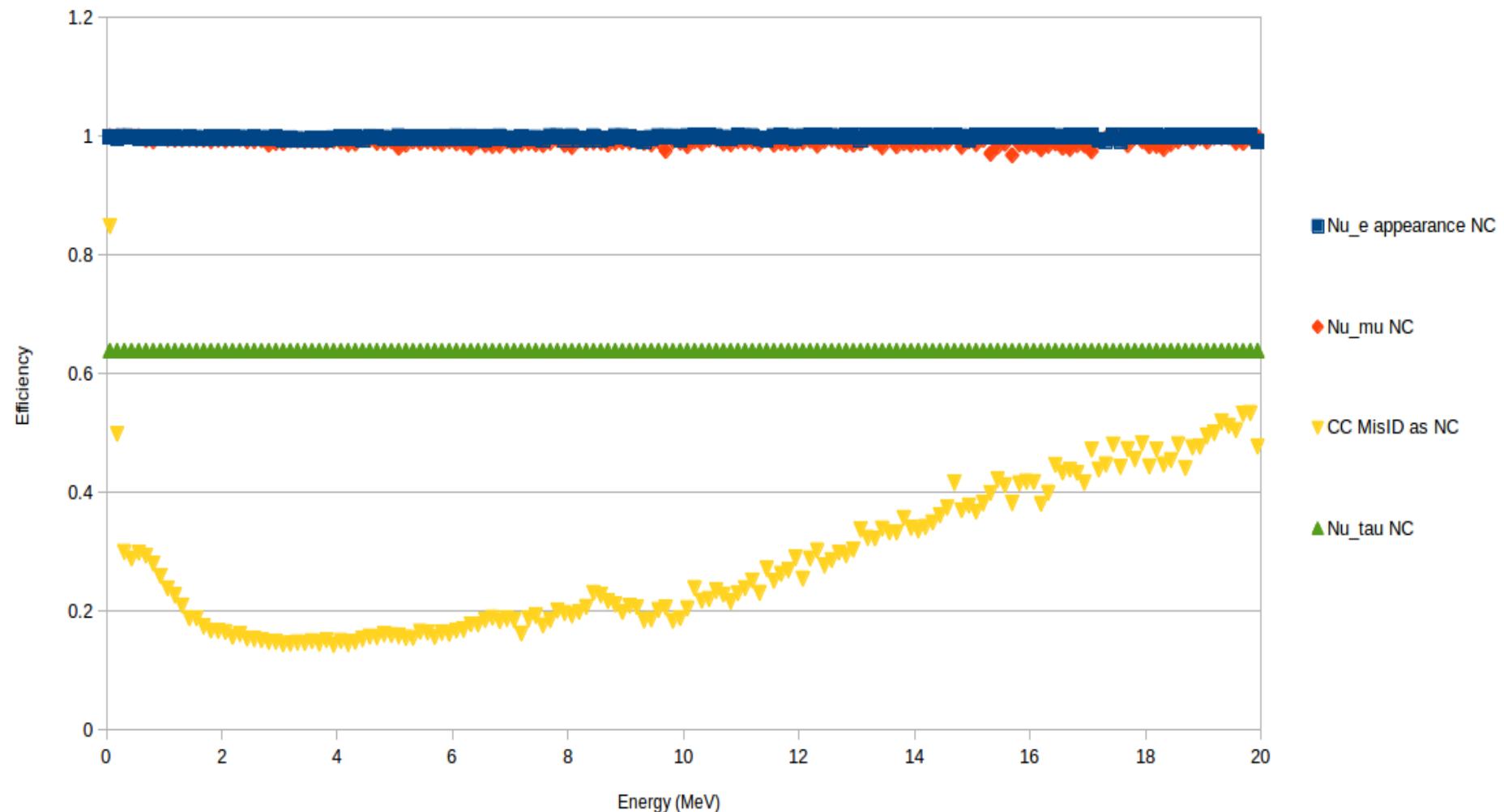


Neutral Current Signal

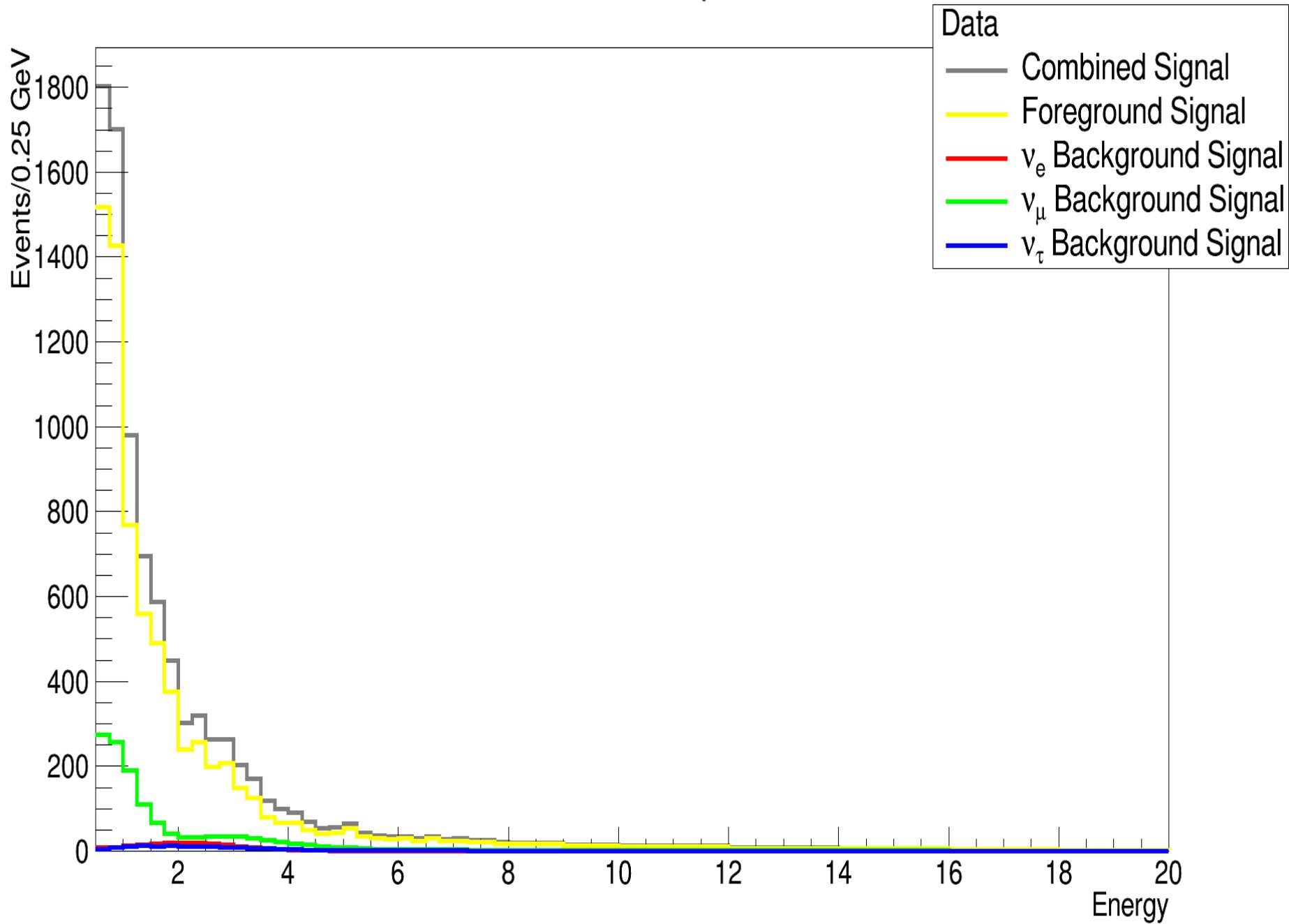
- In order to determine the NC signals, efficiencies for those signals had to be determined.
- Inverting the NC background channel efficiencies.
- What could be mistaken as NC?
 - ν_x CC misidentifications (CC misID)
 - ν_τ , (hadronic)
- Inversion of misID CC efficiencies.

Inverted Efficiencies

Forward Horn Current



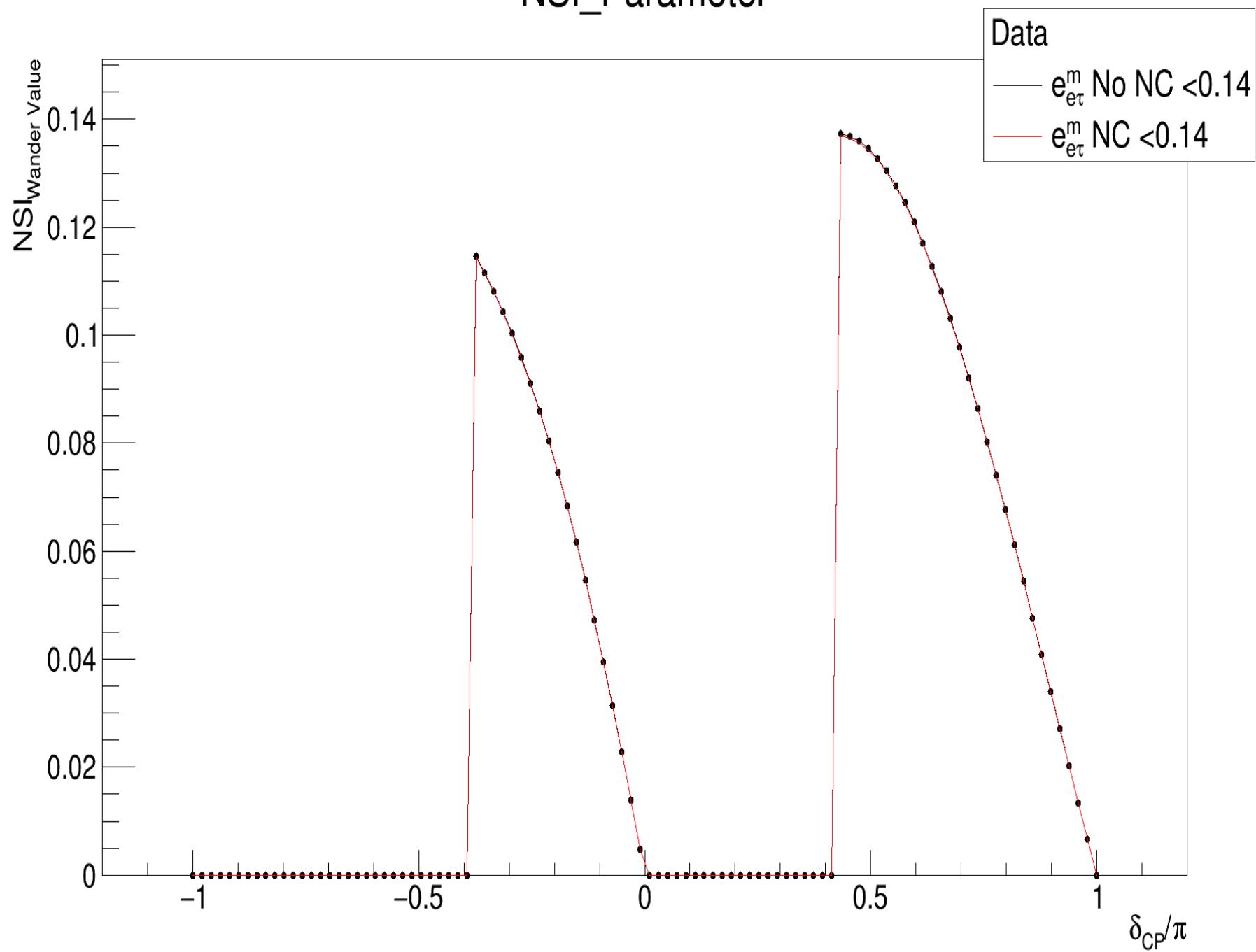
Neutral Current Spectrum



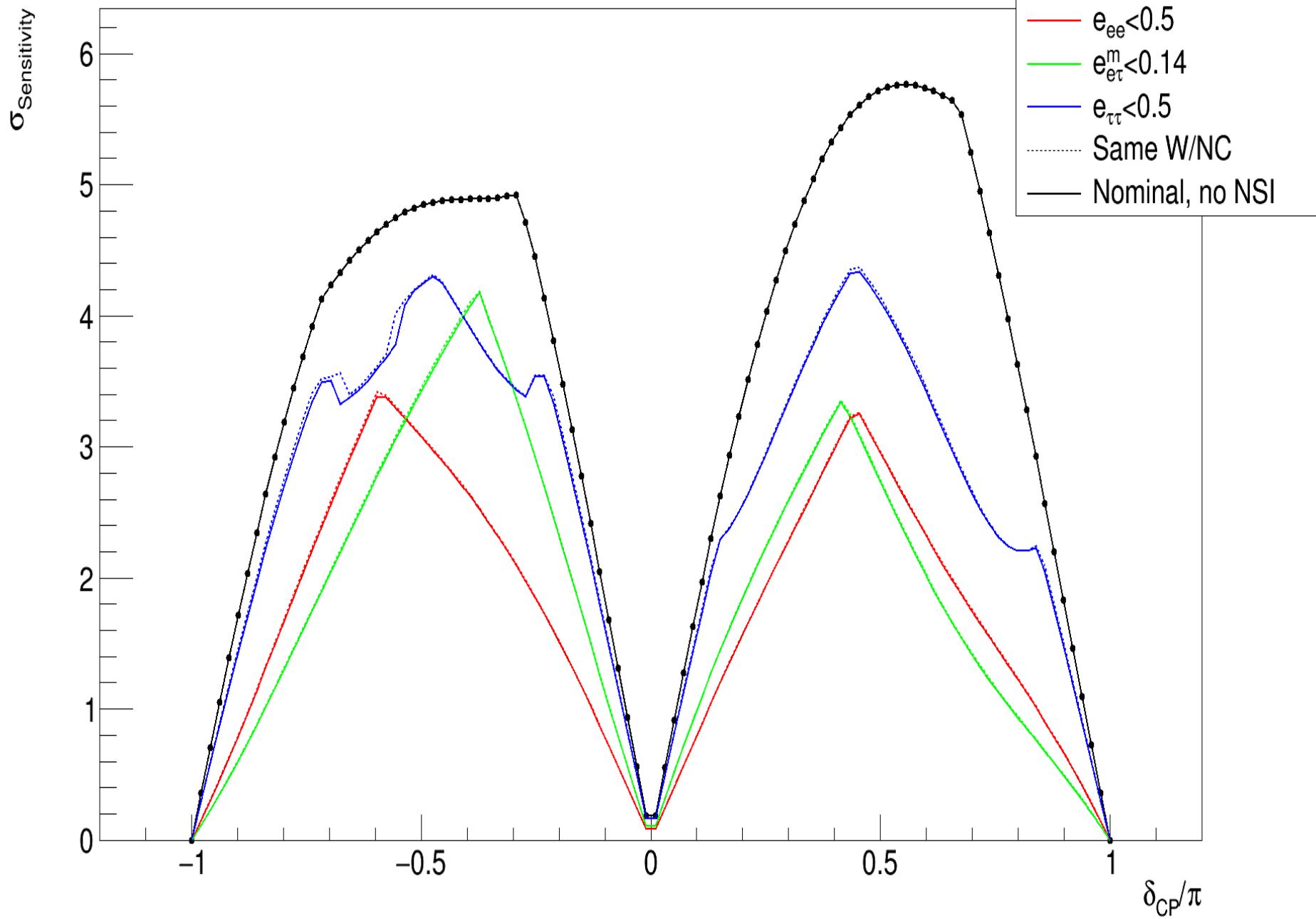
Non-Standard Interactions

- GLoBES Non-Standard Interaction (NSI) package.
 - NSI parameters ($\epsilon_{\alpha\beta}$)
- Predicting the δ_{cp} sensitivity values in allowing for the presence of NSI, both with and without NC.
- Determining the $\%3\sigma$ and $\%5\sigma$ sensitivity of the δ_{cp} values in the presence of these NSI.

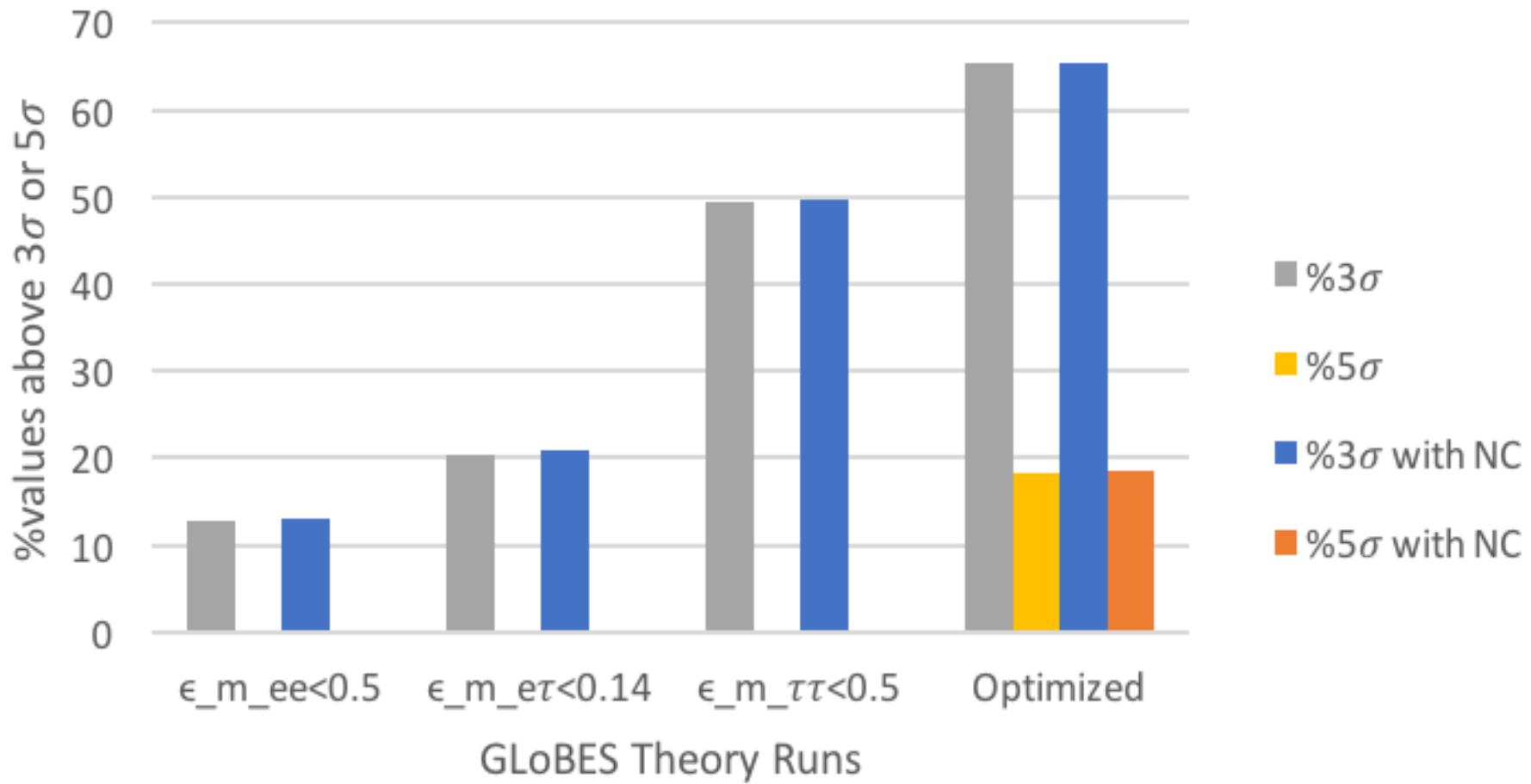
NSI_Parameter



δ_{CP} Sensitivity

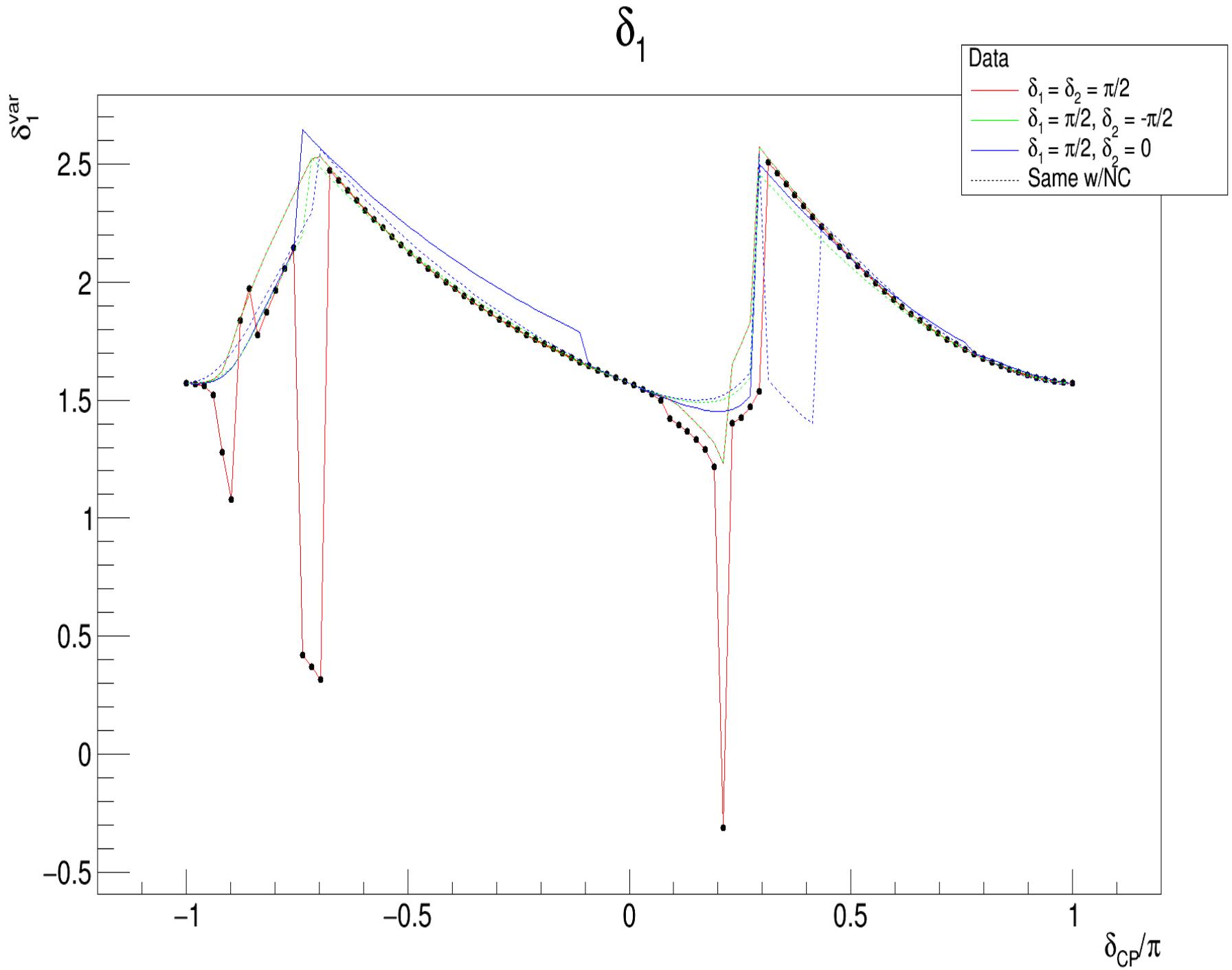


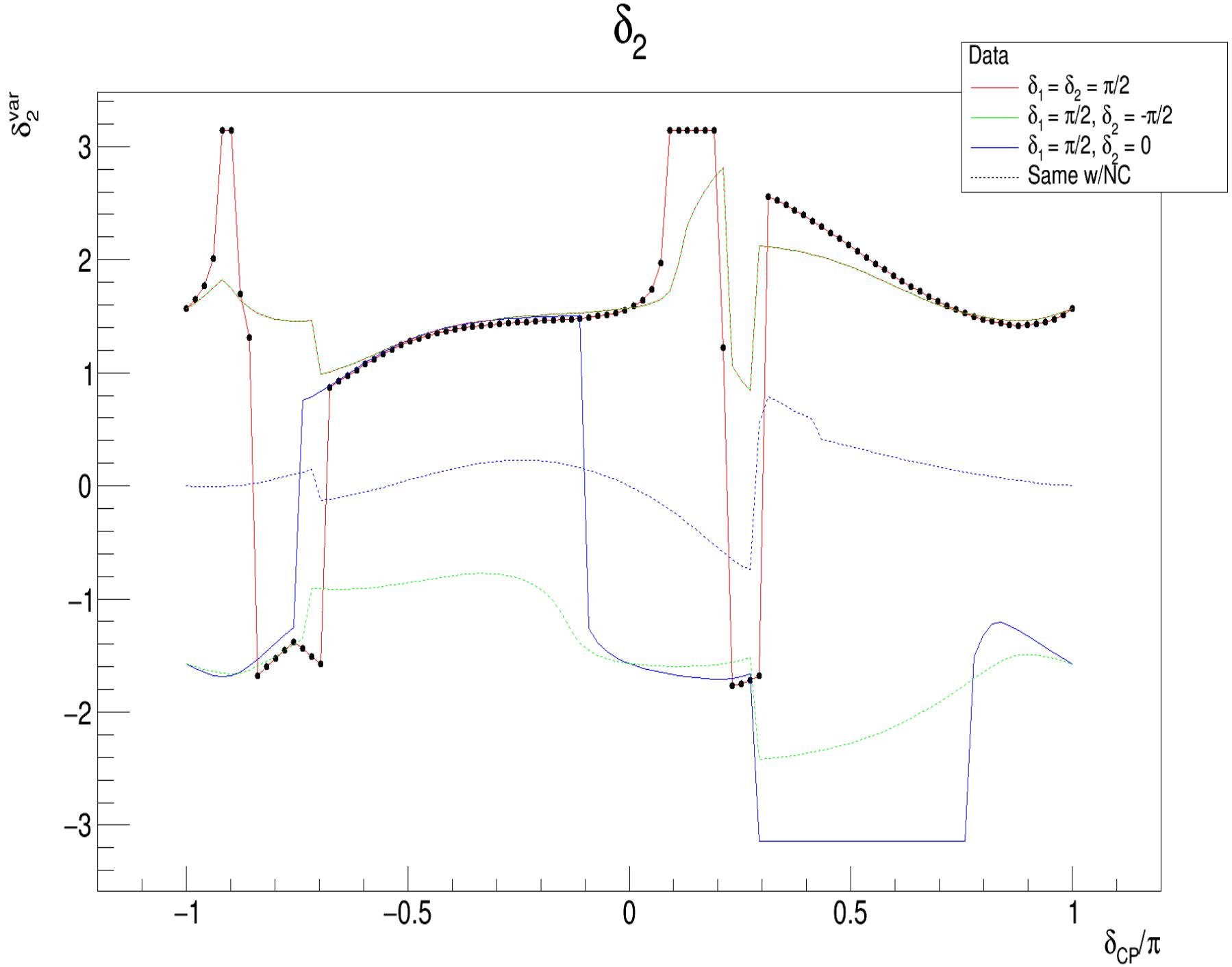
NSI



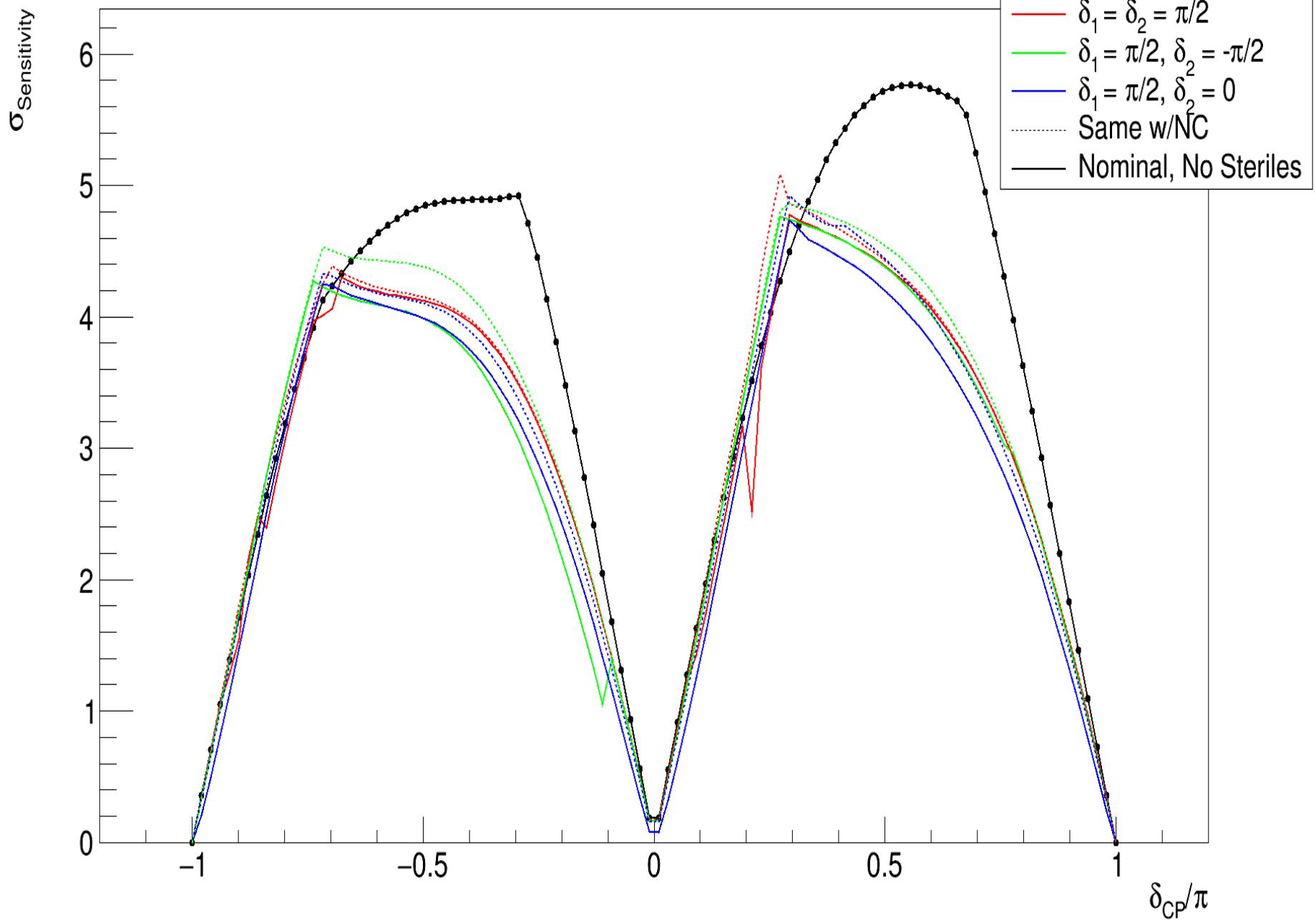
Sterile Neutrino (3+1)

- The (3+1) model, with input values for sterile neutrino parameters.
- The parameters considered are: δ_1 , δ_2 , θ_{14} , θ_{24} , and θ_{34} .
- Implementation of a degeneracy finding algorithm, due to getting stuck in non-physical local minima.
- Implementation of a prior for keeping δ_1 and δ_2 bounded in physical values $[-\pi, \pi]$.

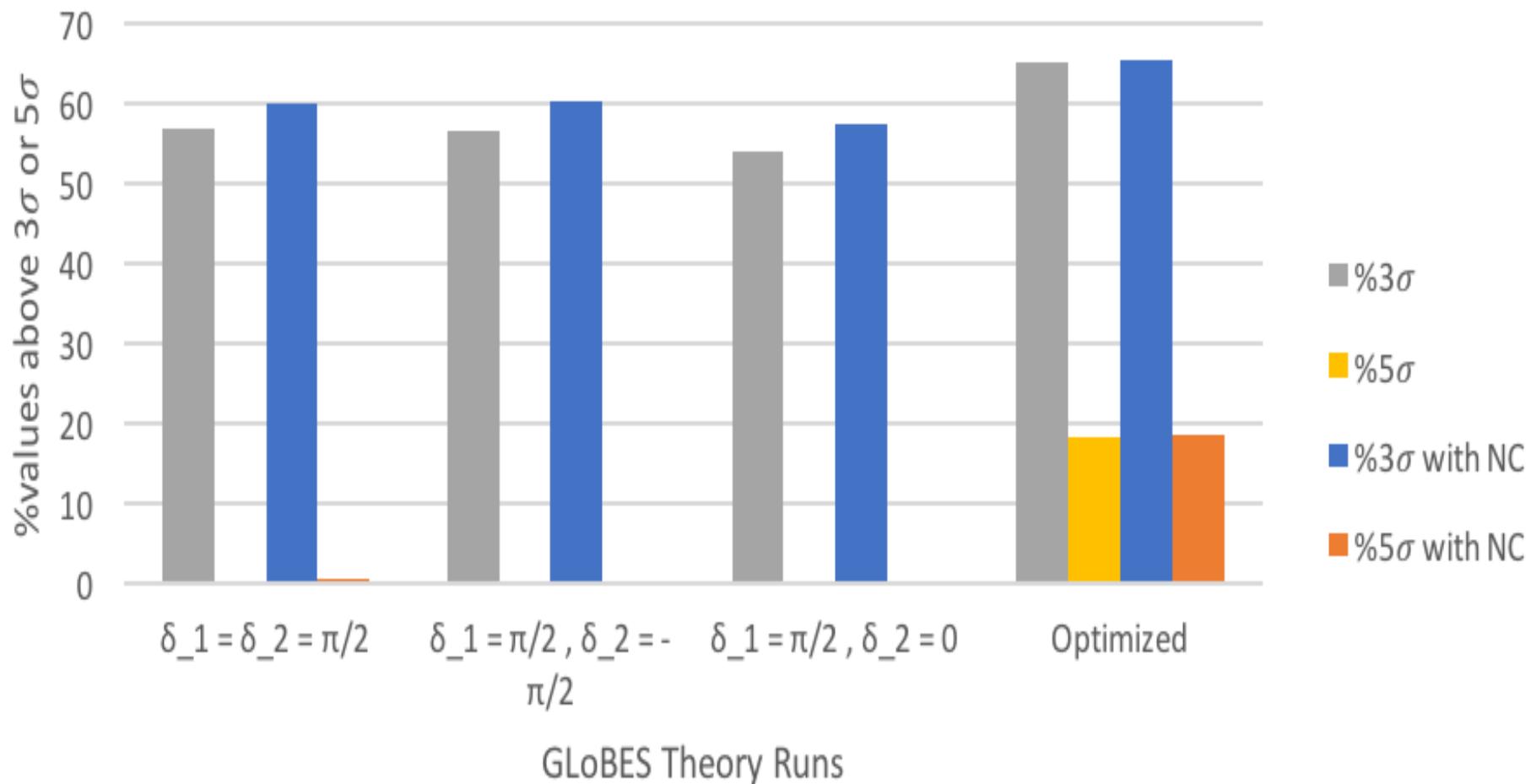




δ_{CP} Sensitivity



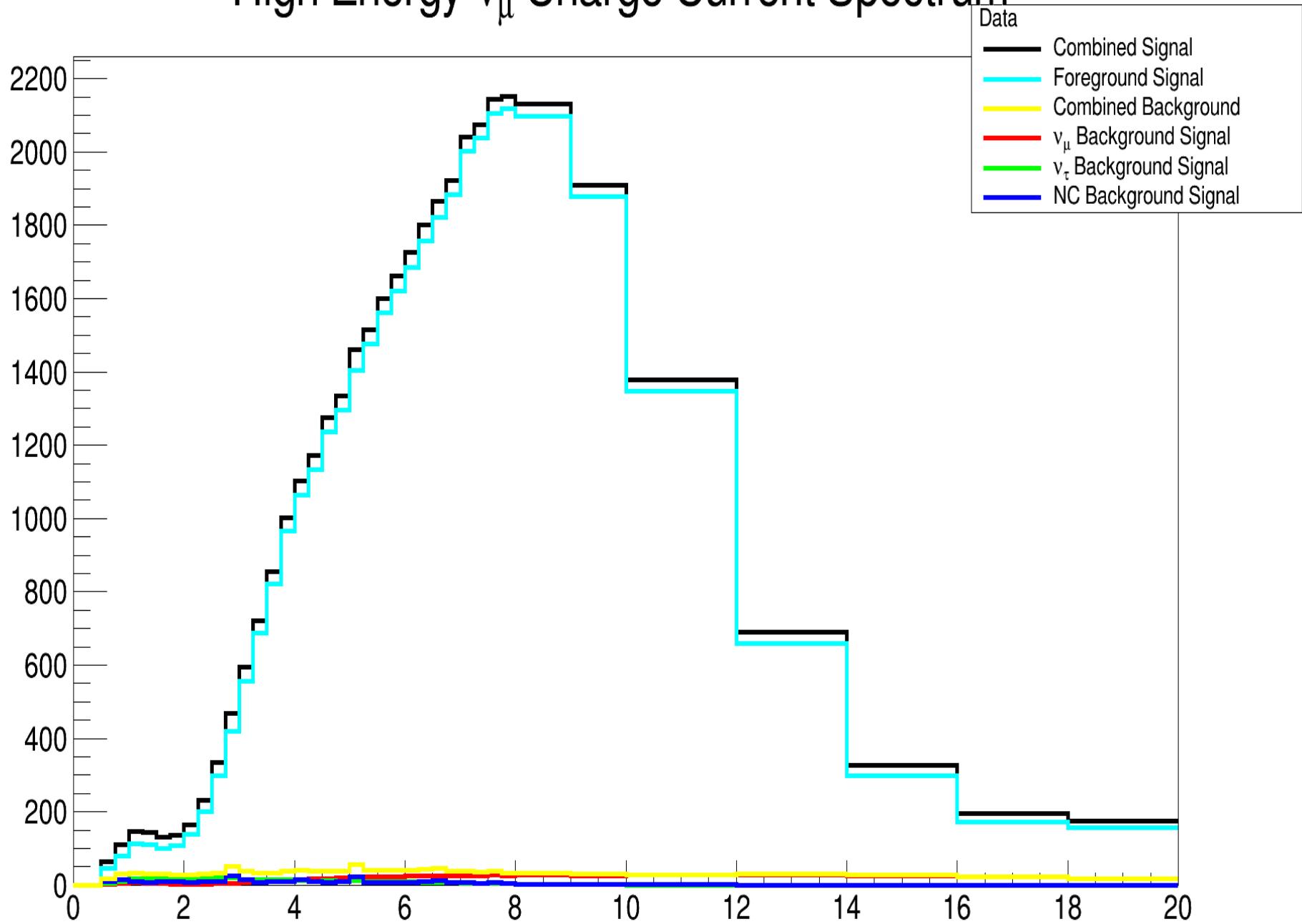
Sterile Neutrino



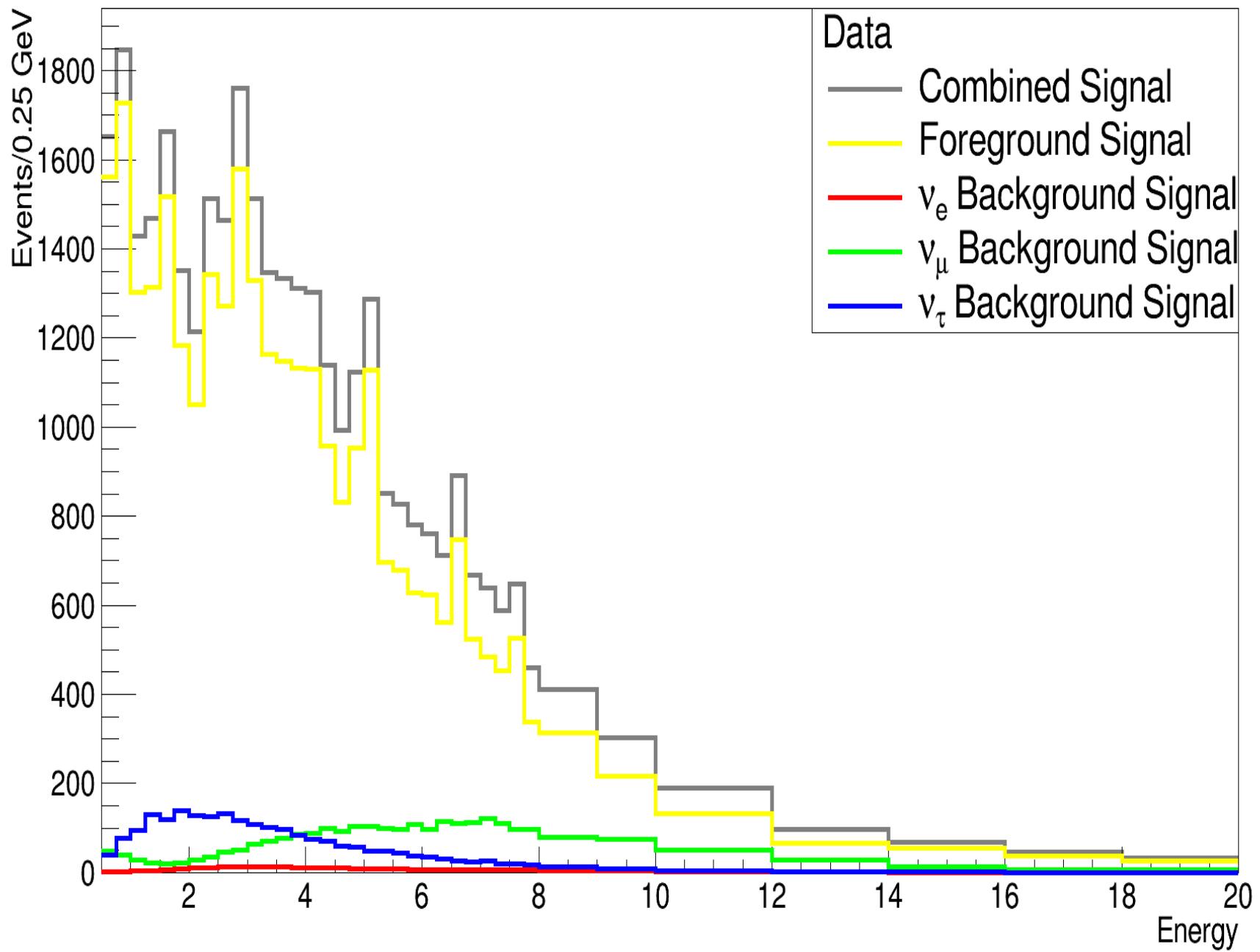
High Energy Beam

- Implementation of a high energy beam with the following specifications:
 - 120 GeV, LBNF target (10cm wide) -2m from Horn 1, NuMI horns 17m apart with 230 kA.
- Mixed beam run times, for 10 years, rather than 7 years.
- Possible complication due to the statistics of the smearing matrix being low.
- This model is expected to mitigate the degrading effects of NSI on the δ_{cp} sensitivity .

High Energy ν_μ Charge Current Spectrum



High Energy Neutral Current Spectrum



δ_{CP} Sensitivity

$\sigma_{\text{Sensitivity}}$

Data
No NSI 5+5 Old Flux
NSI 5+5 Old Flux
NSI 3+2 Old+New Signal
No NSI 3+2 Old+New Signal
Nominal, No NSI, 3.5+3.5

-1

-0.5

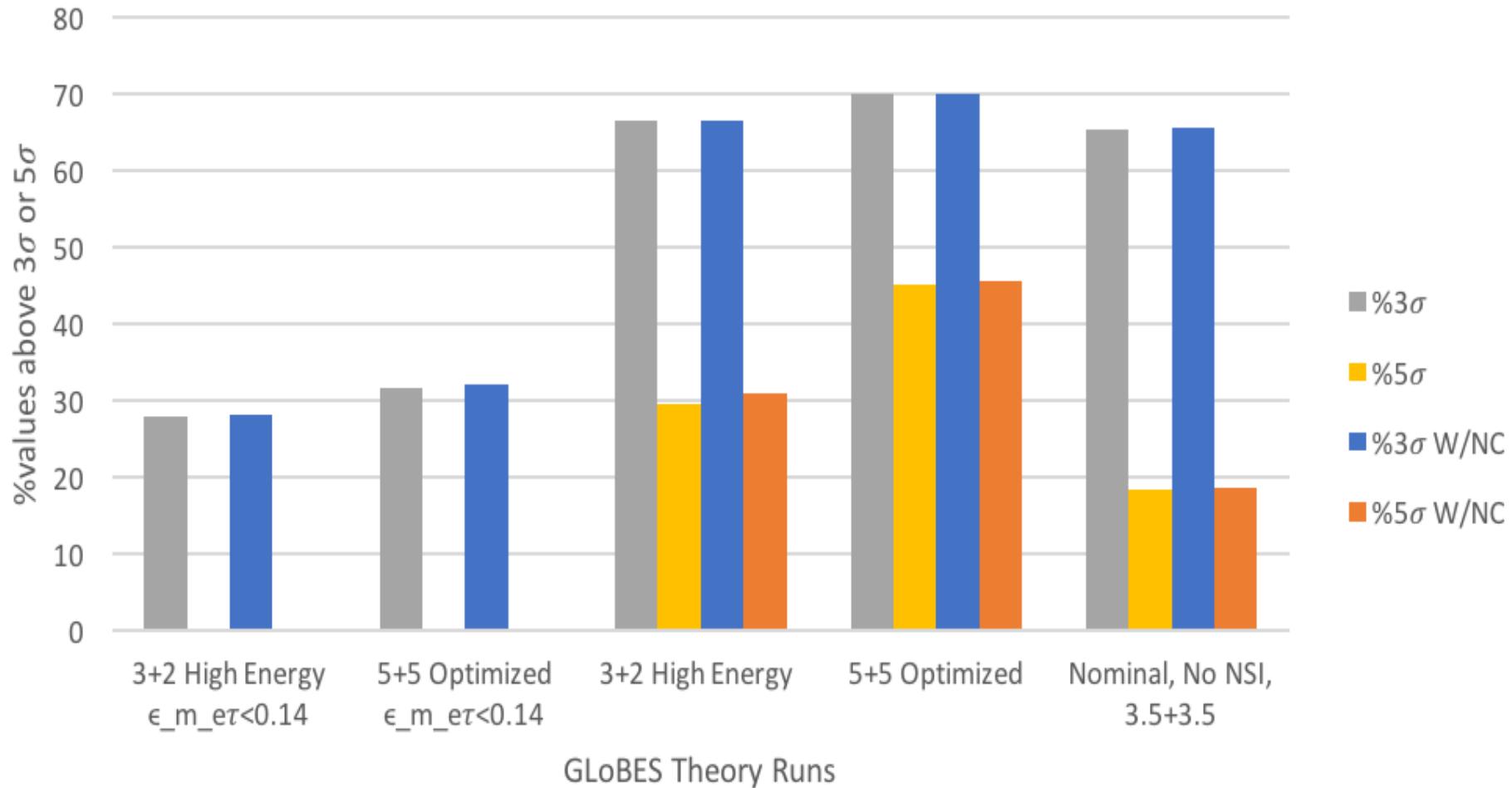
0

0.5

1

δ_{CP}/π

10 Year Runs



Thank You!